**Project Manager's Quarterly Progress Report –3rd Quarter FY 2001**
**U.S. Large Hadron Collider Construction Project**

## 1. PROJECT IDENTIFIERS

| | |
|---|---|
| Reporting Period: | Through **June 30, 2001** |
| Program Sponsors: | DOE High Energy Physics Division/NSF Physics Division |
| DOE/NSF Program Manager: | T. Toohig, (301) 903-4115, timothy.toohig@science.doe.gov |
| DOE/NSF Associate Program Manager: | M. Goldberg, (703) 306-1894, mgoldber@nsf.gov |
| Operations Office: | Chicago Operations Office/Fermi Area Office |
| DOE/NSF Project Manager: | J. Yeck, (630) 840-2530, jim.yeck@ch.doe.gov |

## 2. PROJECT DESCRIPTION

The Department of Energy (DOE) and the National Science Foundation (NSF) have signed agreements committing to collaboration in the construction of the Large Hadron Collider (LHC) at CERN (European Laboratory for Particle Physics) and two of its associated detectors. The U.S. fabrication effort will be carried out at, or under the supervision of, U.S. universities and national laboratories under the terms and conditions described in the International Collaboration Agreement (Agreement) and its Accelerator and Experiments Protocols. The U.S. LHC Construction Project is defined by the goods and services to be provided to CERN under the terms of the Agreement between DOE, NSF, and CERN. These goods and services include DOE contributions to the LHC accelerator, and DOE and NSF contributions to the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid) experiments.

The DOE contribution to the LHC accelerator consists of items provided by DOE National Laboratories and CERN direct purchases from U.S. industrial firms. The scope of these contributions is addressed in the Accelerator Protocol and described in detail in an Implementing Arrangement between the collaborating DOE National Laboratories and CERN. The DOE and NSF contributions to the ATLAS and CMS detectors consist of items supplied by the collaborating U.S. universities and DOE National Laboratories. The scope of these contributions is addressed in the Experiments Protocol and described in detail in Memoranda of Understanding for collaboration on construction of each experiment.

The U.S. LHC Construction Project includes the U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects. This report summarizes the overall status of the U.S. LHC Construction Project effort and includes more detailed status information on each sub-project. Additional information can be accessed at the following web sites:

U.S. LHC Project - http://www.hep.net/doe-hep/lhc.html

| | |
|---|---|
| LHC Project - http://wwwlhc.cern.ch/ | U.S. LHC Accelerator - http://www-td.fnal.gov/ |
| ATLAS - http://atlasinfo.cern.ch/Atlas/Welcome.html | U.S. ATLAS - http://www.usatlas.bnl.gov/ |
| CMS - http://cmsinfo.cern.ch/Welcome.html | U.S. CMS - http://uscms.fnal.gov/ |

## 3. PROJECT MANAGER'S NARRATIVE HIGHLIGHTS

The current list of DOE/NSF project reviews and status meetings is provided below:

| U.S. LHC Construction Project | Event | Date |
|---|---|---|
| U.S. CMS Detector | DOE/NSF Review | May 8-10, 2001 |
| U.S. LHC Accelerator | DOE/NSF Review | May 13-14, 2001 |
| U.S. ATLAS Detector | Quarterly Status Meeting | June 20, 2001 |
| U.S. LHC Accelerator | Quarterly Status Meeting | August 29, 2001 |
| U.S. CMS Detector | Quarterly Status Meeting | August 30, 2001 |
| U.S. ATLAS Detector | DOE/NSF Review | September 20, 2001 |
| U.S. CMS Detector | DOE/NSF Review | November 15, 2001 |
| U.S. LHC Accelerator | DOE Review | December 4-5, 2001 |

The results of these activities are documented in formal reports and meeting notes. The U.S. CMS and ATLAS projects submit monthly reports and the U.S. LHC Accelerator project submits a quarterly report. Current performance data is summarized in the following tables:

Table 3.1, Schedule Performance Indices

| | Planned Complete (BCWS/BAC) | Actual Complete (BCWP/BAC) | Schedule Performance (BCWP/BCWS) |
|---|---|---|---|
| U.S. ATLAS | 49.3% | 48.6% | 99% |
| U.S. CMS | 65% | 56% | 86% |
| U.S. LHC Accelerator | 68% | 65% | 95% |

Table 3.2, Contingency Status (in thousands of dollars)

| | Total Project Cost (TPC) | Budget at Completion (BAC) | Contingency | Budgeted Cost of Work Performed (BCWP) | Remaining Work to be Performed (BAC-BCWP) | Contingency/ (BAC-BCWP) |
|---|---|---|---|---|---|---|
| US ATLAS | 163,750 | 133,812 | 29,938 | 65,054 | 68,758 | 44% |
| US CMS | 167,250 | 138,826 | 28,424 | 77,785 | 61,041 | 47% |
| US Accelerator | 110,000 | 103,196 | 6,804 | 66,700 | 36,496 | 19% |

Table 3.3, Cost & Schedule Performance (in thousands of dollars) Indices

| | Cumulative Costs to Date | | | | | Costs at Completion | | |
|---|---|---|---|---|---|---|---|---|
| | Budgeted Cost | | | Variance | | | Revised | |
| | Work Scheduled | Work Performed | Actual Cost | Schedule | Cost | Budgeted | Estimate | Variance |
| U.S. ATLAS | 66,015 | 65,054 | 64,777 | -961 | 277 | 163,750 | 163,750 | 0 |
| U.S. CMS | 90,328 | 77,785 | 69,873 | -12543 | 7912 | 167,250 | 167,250 | 0 |
| U.S. LHC Accelerator | 69,851 | 66,700 | 65,934 | -3151 | 766 | 110,000 | 110,000 | 0 |
| CERN Invoices | 23327 | 23327 | 23327 | 0 | 0 | 90,000 | 90,000 | 0 |
| U.S. LHC Total | 249,521 | 232,866 | 223,911 | -16655 | 8955 | 531,000 | 531,000 | 0 |

## 4. PROJECT MANAGER'S ASSESSMENT

The U.S. projects continue to meet their goals and are reliable and influential partners in the construction of the ATLAS and CMS detectors and the LHC machine.

**Cost –** Cost performance is good as material contracts are typically below estimates and labor costs continue to track close to plans. Each project maintains an adequate level of contingency, although the present EAC for the U.S. LHC Accelerator project indicates a contingency level that is of minor concern. Favorable changes in cost variance for the Accelerator project have been achieved through recent rebaselining of the BNL and FNAL programs. Rebaselining is also in process for the LBNL program which is presently undergoing review by the US LHC Accelerator Project Office, with particular focus on the cryogenic feedbox system .

The U.S. LHC Accelerator project office has been actively and aggressively addressing the contingency concern through careful revision of the estimate to complete for all three Lab's activities. Change control and review has been exercised by the project office and Inter-Lab Steering Committee to rebaseline superconducting cable tests and dipole magnet work at BNL; absorber, luminosity instrumentation and cryogenic feedbox work at LBNL; IR quad work at FNAL and accelerator physics work across Labs. Presently the LBNL cryo feedbox rebaseline proposal has been sent back for further review. Present Obligation Profile projections for FY02, as compared to expected FY02 funding, may necessitate adjustment of CERN Direct Payment funding profile to mitigate a potential shortfall.

The U.S. CMS contingency situation has remained steady, and the project is carefully monitoring apparent divergence of costs in the Endcap Muon (EMU) subsystem. The project is reviewing cost growth in this system, and there will be a Quarterly Status Meeting at UCLA this week, where EMU production is to get underway, to further address this issue.

The U.S. ATLAS project continues to carefully manage contingency, and is undertaking a sensitivity analysis for each subsystem to re-confirm realistic contingency estimates. The project has been directed to review Technical Coordination efforts to date, to validate any further use of contingency in that important area.

**Schedule** - Schedule performance is measured through milestone completion and by earned value. These measurements indicate that schedule progress is slightly behind plans averaging about ninety-three percent of the baseline plan, indicating no major slipages in schedule. The total U.S. LHC Project is fifty-seven percent complete, based on earned value. CERN expects to complete construction of the LHC in 2005 and initiate collider commissioning in 2006. Current CERN schedule calls for first collisions in April 2006 and first physics in August 2006. The U.S. schedules are consistent with this goal.

CERN has been working with experiments to agree on a revised schedule, and this has been adopted by US CMS for present planning purposes. Once CMS officially adopts this schedule, US CMS will initiate a change request that will reflect this version and adjust US CMS milestones accordingly. The US CMS Project Office is tracking this schedule and ascertaining

potential cost impacts on the project, to better plan installation and commissioning as well as project completion. U.S. ATLAS is updating the baseline schedule and float for each subsystem to reflect new CERN required delivery dates, based on the new CERN schedule and maintaining the project completion date of September 2005.

**Technical –** Good technical progress continues across the project, and we remain confident that the U.S. deliverables to CERN can be realized with the planned funding. The U.S. LHC Construction Project deliverables are accepted by CERN and approved by the DOE/NSF Joint Oversight Group. We expect to provide additional items to CERN, within the approved funding, should cost performance be favorable.

Important milestones are being met. The Accelerator project has begun Interaction Region quad production assembly a made the decision that the U.S. Project will not include RF region quadrupoles. U.S. CMS Hadron Calorimeter barrel wedges for half the barrel have been installed with scintillator tiles, and are being moved to the CMS surface building for assembly. U.S. ATLAS has delivered the Liquid Argon Calorimeter Barrel Cryostat to CERN. Additional technical Project highlights are given in section 5, and shown in the photos

**ISSUES**

**LHC Schedules –** CERN has agreed on a new schedule for the machine, with the ring closed/cold by 12/05, first collisions/pilot run starting 4/06, followed by a 3 month shutdown and first physics starting 8/06. Both experiments are revising and reworking initial detector configuration and installation plans with the goal of initial detectors ready for first collisions and complete detectors (with staging options) ready for the first physics run. ATLAS is completing a detailed, multi-phased installation scenario taking into account the delay in the availability of the underground cavern. CMS is planning and identifying resource issues associated with moving more assembly, testing and installation activities from the underground to the surface facility. DOE and NSF staff continue to closely monitor this planning activity.

**ATLAS and CMS Resources**– Estimates of the resources required to complete the experiments exceed the funding currently identified, as discussed at the April '01 Resource Review Board (RRB) meeting. Funding shortfalls are driven by several factors: various institutes not meeting their original commitments, improved estimates of the funding required to complete the detectors, cost overruns on core items, exchange rate problems, and (mainly for CMS) civil construction delays. At the RRB meeting, both collaborations and CERN indicated that they will work with the international Funding Agencies to seek additional resources, or develop appropriate work-around plans for completing the detectors. CMS and ATLAS are currently ~50% complete. Experiment and civil construction cost status will be presented to the CERN Council and further addressed in December 2001.

**Radiation Hard Electronics -** Significant challenges remain in the development of radiation hard electronics for the ATLAS and CMS experiments including production yields and limited vendor options. Export license and dual-use technology issues are additional complications.

# 5. NARRATIVE SUMMARY

## 5.1 U.S. ATLAS CONSTRUCTION PROJECT

**ATLAS International** – ATLAS project and technical management have nearly completed a major effort to re-baseline the various schedules (sub-detector, infrastructure and common projects) to meet new installation dates. Start of installation could be as early as February 2003, when UX15 cavern should be finished. ATLAS Week was held at BNL in June 2001, with a major focus on Technical Coordination and Integration. Other ATLAS highlights are summarized below:

- Point 1 surface buildings (control, gas, cooling and ventilation) have been handed over to CERN; primary cooling towers and detector 66 kV electrical substation are commissioned.
- Technical cavern USA15 and its access shaft are almost finished; main cavern wall and vault concreting is proceeding and further main cavern excavation will continue in August 2001.
- Two new types of internal ATLAS reviews are in place (Production Advancement and System Overviews), and have been conducted for some detector subsystems.
- Tile Calorimeter module construction is well advanced, with over 50% of the modules ready, and new ones arriving monthly at CERN.

**U.S. ATLAS** - The overall project, as of June 30, 2001, was actually 51.6 percent complete versus the 52.4 percent planned. A DOE/NSF Quarterly Status Meeting was held at Brookhaven National Laboratory on June 20, 2001. The U.S. Collaboration continues to make good technical progress, with no major technical issues identified. Costs have been controlled such that contingency as a fraction of cost to go has not been reduced. Most U.S. ATLAS subsystems are currently in production, and strong progress has been reported in the area of radiation-hard electronics. Schedule status indicates that U.S. ATLAS should meet ATLAS need dates for U.S. deliverables. Listed below are project highlights:

- Silicon Strip System Production Readiness Review for the Integrated Circuit (IC) electronics was passed; first production ICs should arrive in August.
- Transition Radiation Tracker Mechanics: Six modules are completed at Indiana, seven modules completed at Duke, and eight modules in production.
- Liquid Argon Calorimeter Barrel Cryostat arrived at CERN; signal feedthrough production is on schedule and HV feedthrough parts are nearly ready for shipment to CERN.
- Tile Calorimeter module construction is going well in the U.S, and 26 modules (out of 36 assembled mechanically) have been instrumented, tested, and shipped to CERN.
- Muon Spectrometer Monitored Drift Tube chamber sites have started retooling for the next chamber series; delivery of parts for tube and base chamber construction, and tube production, has been ahead of need and off the critical path.
- Trigger/DAQ User requirements and design documents are being reviewed. and the level 1-level 2 interface document is being updated; computer architecture evaluation and feedback of useful timing information to the offline developers is progressing.

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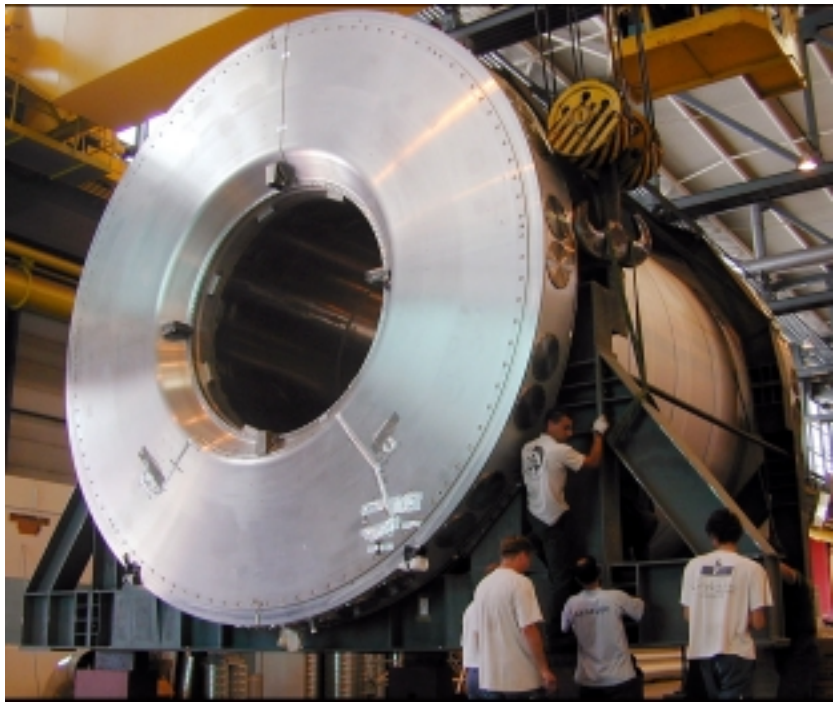
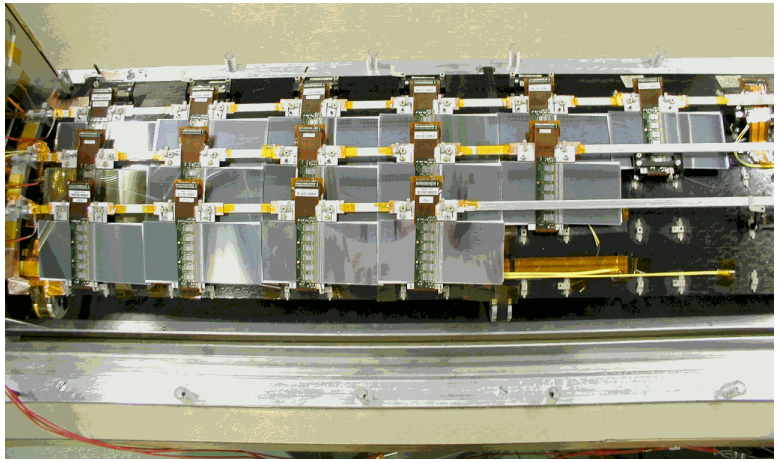


Left- The ATLAS liquid argon calorimeter barrel cryostat after arrival at CERN from Japan. It was fabricated by Kawasaki Heavy Industries Ltd., managed and under under contract from Brookhaven National Laboratory (BNL) as part of the U.S. ATLAS Project.

This cryostat, an important U.S. deliverable, consists of two concentric cylinders made of aluminium: the outer vacuum vessel, 5.5 m in diamater and 7 m long, and the inner cold vessel which will contain the electromagnetic barrel calorimeter immersed in liquid argon. The cryostat is now located in building 180 where it will be equipped with 64 feed-throughs which serve for the passage of 122,880 electrical lines which will carry the signals of the calorimeter.



Right- The ATLAS Inner Detector Semi-Conductor Tracker (SCT) group passed an important milestone when the barrel system test performance was reviewed. The picture shows 15 SCT barrel modules at CERN, where tests supported by the University of California-Santa Cruz indicated that the design of the barrel module meets the electrical performance requirements of ATLAS.

The four barrel production clusters in the U.S, Japan, Scandinavia, and UK have all built several modules and are now preparing their infrastructure and tooling for mass-production of more than 2000 modules

## 5.2 U.S. CMS CONSTRUCTION PROJECT

**CMS International** – CMS project managers and coordinators are finalizing schedule milestones for the revised baseline that addresses constraints concerning availability of the underground experiment cavern. Ready for installation milestones are being introduced to de-couple pre-assembly of major items from their use in the master assembly sequence, assuming delivery of experiment and service caverns in mid-2004. Shrinkage of the underground window will likely lead to cabling and commissioning defining CMS critical path, rather than mechanical assembly. Other CMS highlights are summarized below:

- Largest single CMS element, inner vacuum tank which will house CMS magnet superconducting coil and support inner detectors, arrived at Point 5.
- Construction of surface buildings (cooling, ventilation and gas) is progressing well, with hand-off to CERN in July, 2001.
- Digging of pillar between USC5 and UXC5 is finished and concreting has started.
- Hadron Calorimeter Readout Box was approved for manufacture after resolution of technical integration issues; PNPI and IHEP sites started pre-production of Muon CSC chambers.

**U.S. CMS** – The overall project, as of June 30, 2001, was actually 56 percent complete versus the 65 percent planned. A DOE/NSF full review was conducted May 8-10, 2001 at Fermilab. U.S. CMS is performing well with respect to technical and cost goals, while schedule remains a closely monitored issue. Progress is being made with calorimeter and muon system electronics on the critical path affecting further production of some items. A DOE/NSF Quarterly status meeting is scheduled to be held on August 30, 2001 at UCLA, a site with responsibilities for electronics and muon systems. Listed below are project highlights:

- Production of the Muon Cathode Strip Chamber (CSC) panels is going ahead at the rate and at the cost estimated in the WBS cost estimate (over 50% complete), and production of CSC chambers at Fermilab is proceeding well.
- The first Hadron Calorimeter (HCAL) half barrel at CERN is being reassembled in the CMS Surface Building-SX5; insertion of the optics into the first barrel wedges was completed at CERN as planned, and U.S. production of the HCAL Barrel scintillator tiles is on schedule;
- A muon trigger electronics voltage regulator issue has been addressed by finding a suitable commercial device, which should remove the low voltage board from the critical path; the DAQ effort continues essentially on budget and on schedule.
- Forward Pixel effort is now moving from R&D to prototyping, and has defined construction milestones through to completion.
- Assembly and installation of major sections of the CMS magnet end-cap steel yoke (U.S. Common Project) assemblies has been completed.
- Set-up and debugging of the Silicon Tracker module gantry system at Fermilab for automated production has made substantial progress, and planning for additional assembly facilities at UC-Santa Barbara is underway.

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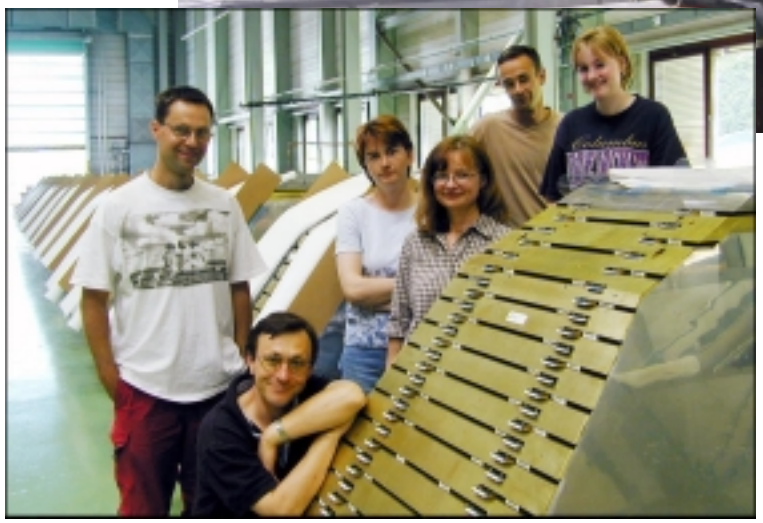

Above- U.S. CMS team from Fermilab and University of Rochester at CERN, after completing installation of the Hadron calorimeter (HCAL) scintillation tiles into the barrel wedges at Building 186;

Above (Top)- HCAL barrel wedges are presently being moved from Building 186 to the CMS Surface Building SX-5 for assembly.


Above- Completed assembly of a CMS Magnet end-cap steel yoke section (YE-2) at CERN, part of the U.S. CMS Common Projects.

## 5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT

**LHC** – Commissioning schedule important dates remain as follows: first octant test- 4/04; last dipole produced-4/05; rings cold-12/05; first beam-2/06; pilot run-4/06; shutdown-5-7/06; physics run-8/06. The CERN Director-General has chaired a series of joint LHC Machine-Detector meetings to provide a regular forum for mutual planning between the accelerator and experiments.

- The first LHC dipole test results were very satisfactory, with first quench near the nominal operating level (8.34 Tesla), and no further quench when the magnet was powered to the ultimate field limit (9 Tesla).
- Cryogenic dipole assembly call for tender is out, with adjudication expected by September; contracts for all main components of dipoles are now placed and series production has started, but slow progress by superconducting cable vendors continues to pace the dipole program.
- CERN and the U.S. are working together as necessary to achieve tighter configuration management, as final designs are translated into production of components
- One of the new transfer tunnels to provide protons from SPS to LHC (T12) has broken through into the LHC tunnel near Point 2.

**U.S. LHC Accelerator** - The overall project, as of June 30, 2001, was actually 65 percent complete versus the 68 percent planned. A DOE/NSF review was held at Fermilab on May 14-15, 2001 with the next DOE/NSF Quarterly Status meeting scheduled for August 29, 2001 at Fermilab. The level of contingency available in the project is a minor concern, due to cost growth identified during the last estimate to complete. Project management continues to fully evaluate project scope and contingency across the entire project to increase the available contingency budget. There are no major issues with technical progress and the schedule of deliverables remains well in advance of CERN requirements. Project highlights are listed below:

- [Fermilab] Prototype quadrupole cold mass and cryostat (Q2P1) was completed, installed on the test stand, tested at 2K and met all requirements on the first cycle. A second thermal cycle is planned for next quarter. Quadrupole cold mass production has begun, and the first unit collared coil was completed. The CERN/US/KEK meeting was held at KEK, including a visit to Toshiba to see the prototype magnet and to perform a trial insertion of beam tube .
- [BNL] Magnet production continues: all D1 cold masses have been assembled and are undergoing surveying, straightening and preparation for piping installation. The first D2 cold mass and second D2 collared coils are essentially complete. CERN is changing the configuration at LHC Insertion Region 4 which will reduce the number of D3 and D4 magnets and simplify the interconnects, although this will require some redesign of D4 connections.
- [LBNL] Design of DFBX cryogenic feedboxes is over 70% complete. Letters of Inquiry have been sent to vendors interested in fabricating the vacuum boxes, helium vessels, thermal shields and vapor cooled leads. Detailed design of the TAN and TAS absorbers is nearly

complete and the design effort has ramped to a low level with effort concentrating on procurement of parts and plans for assembly. The large steel and copper pieces have been received and the copper beam tube channels have been machined.

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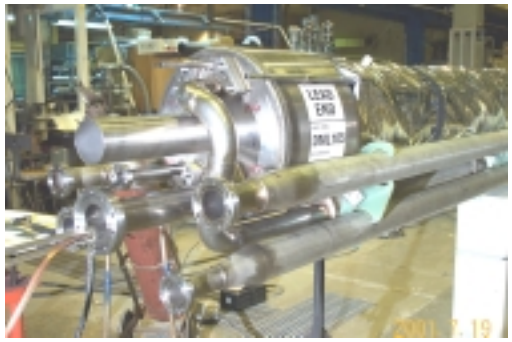
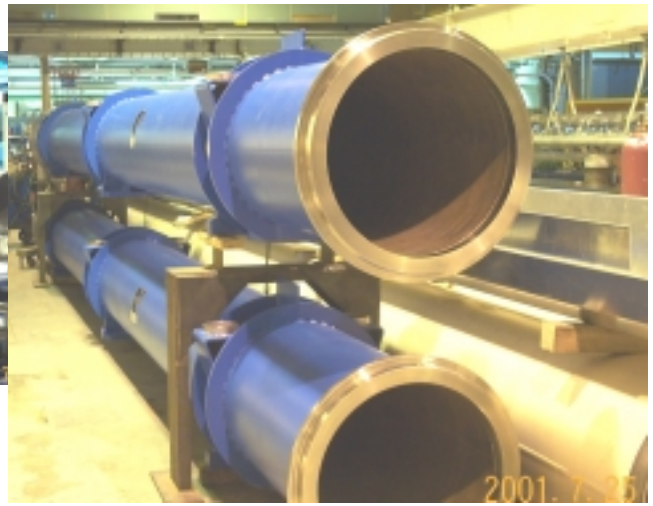
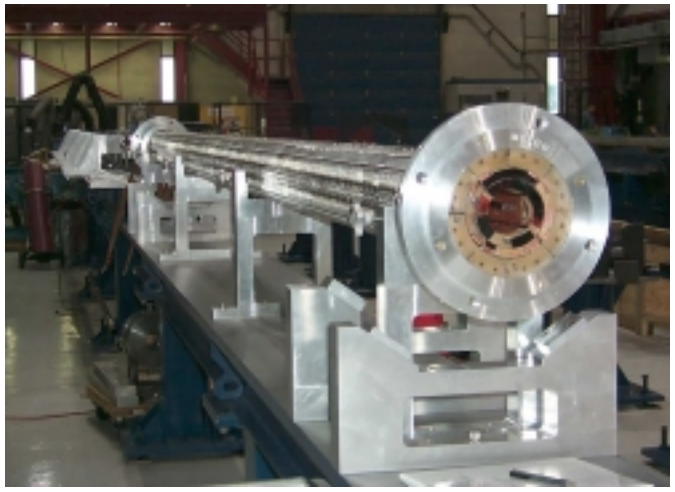


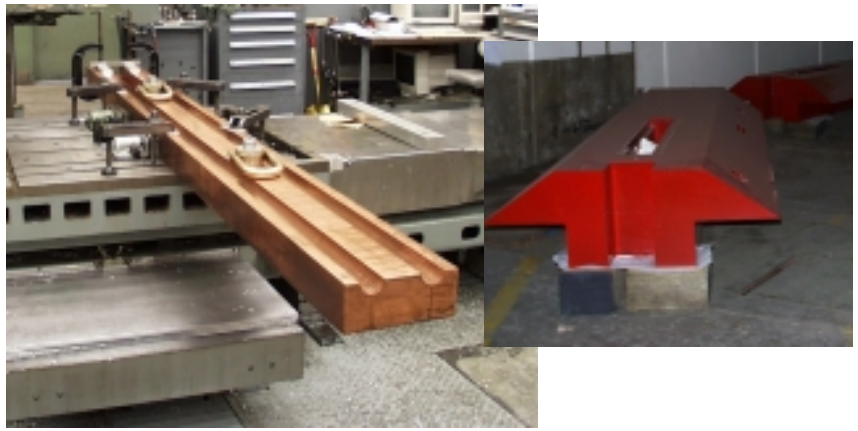
Above- Completed cold mass assembly for the first production D1 dipole at BNL. The lead end is shown on the left and the non-lead end is shown on the right.



Above- Vacuum vessels for D1 magnets at BNL.



Left- Completed collared coil for the first production quadrupole, MQXB01 at Fermilab.



Above (Left) Slots being machined in TAN copper absorber for beam tubes and (Right) Top iron shielding for TAN absorber, both at

**CERN Direct Purchases** - DOE reimburses CERN for their payments to qualified U.S. vendors [Reference U.S.-CERN Agreement and Accelerator Protocol]. The status is shown in Table 5.1.

Table 5.1, Status of DOE Payments (in $000)

| Contract Item | Company (U.S. Supplier) | Amount | Contract | w/ options |
|---|---|---|---|---|
| Niobium-Titanium Alloy Bars | Wah Chang | 18,668 | 38,667 | 48,431 |
| Niobium Sheets | Wah Chang | 2,682 | 5,633 | 6,951 |
| Polyamide Insulation Film | Kaneka High Tech Materials | 659 | 5,425 | 6,510 |
| Superconducting Cable | IGC Advanced Superconductors | 1,151 | 16,447 | 20,985 |
| LHC BPMS Button Feedthroughs | Ceramaseal | 0 | 898 | 1,003 |
| Cryogenic Temperature Sensor | Lakeshore | 167 | | |
| Cryogenic Helium Mass Flowmeters | (tbd-contract in process) | 0 | 1,200 | 1,200 |
| (tbd-contract in process) | (tbd-contract in process) | 0 | (tbd) | 3,134 |
| Totals | | 23,327 | 68,270 | 88,214 |

## 6. FINANCIAL/COST STATUS AND PLANS

### TOTAL PROJECT FUNDING PLAN (then year millions of dollars)*

| Fiscal Year | FY96 | FY97 | FY98 | FY99 | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Machine Funding Profiles (DOE)** | | | | | | | | | | | |
| US LHC | 2.00 | 6.67 | 14.00 | 15.40 | 24.92 | 9.36 | 14.20 | 11.20 | 8.33 | 3.92 | 110 |
| CERN Direct | 0.00 | 0.00 | 0.00 | 8.09 | 8.29 | 17.88 | 8.00. | 10.90 | 21.00 | 15.84 | 90 |
| Machine Total | 2.00 | 6.67 | 14.00 | 23.49 | 33.21 | 27.24 | 22.2 | 22.1 | 29.33 | 19.76 | 200 |
| **Detector Funding Profiles (DOE and NSF)** | | | | | | | | | | | |
| US ATLAS | 1.70 | 3.71 | 10.05 | 25.63 | 28.43 | 26.77 | 21.85 | 25.89 | 14.69 | 5.03 | 163.75 |
| DOE | 1.70 | 3.71 | 10.05 | 9.00 | 16.49 | 14.48 | 9.2 | 18.6 | 14.69 | 5.03 | 102.95 |
| NSF | 0.00 | 0.00 | 0.00 | 16.63 | 11.94 | 12.29 | 12.65 | 7.29 | 0.00 | 0.00 | 60.80 |
| US CMS | 2.30 | 4.62 | 10.95 | 38.03 | 24.26 | 21.23 | 21.81 | 21.73 | 15.98 | 6.34 | 167.25 |
| DOE | 2.30 | 4.62 | 10.95 | 32.51 | 20.30 | 17.15 | 17.6 | 19.3 | 15.98 | 6.34 | 147.05 |
| NSF | 0.00 | 0.00 | 0.00 | 5.52 | 3.96 | 4.08 | 4.21 | 2.43 | 0.00 | 0.00 | 20.20 |
| Detectors Total | 4.00 | 8.33 | 21.00 | 63.66 | 52.69 | 48.00 | 43.66 | 47.62 | 30.67 | 11.37 | 331.00 |

### TOTAL DOE & NSF FUNDS, COSTS, & COMMITMENTS (cumulative $000)†

| U.S. LHC Construction Project | A = Funds Allocated | B = Estimate Actual Costs | C = Open Commitments | D= B+C Total | A–D = Funds Available |
|---|---|---|---|---|---|
| U.S. ATLAS | 96,290 | 64,777 | 6,975 | 71,752 | 24,538 |
| U.S. CMS | 101,390 | 69,873 | 19,258 | 89,131 | 12,259 |
| U.S. LHC Accelerator | 72,350 | 63,006 | 2,928 | 65,934 | 6,416 |
| CERN Direct Purchases | 34,260 | 23,327 | 0 | 23,327 | 10,933 |
| Total | 304,290 | 220,983 | 29,161 | 250,144 | 54,146 |

* This report includes a revision to the funding profile for the U.S. LHC Construction Project that is addressed in the FY 2001 budget planning for DOE. The revision to the original profile was made in order to better match the needs of the construction projects. This report also includes a change in the distribution of funds between the U.S. LHC Accelerator project and the CERN direct project to address delays in CERN invoices.

† Based on financial reports from the U.S. LHC construction projects. NSF funding is provided after the beginning of the fiscal year and therefore it is necessary to carry-over funding into the subsequent fiscal years.

## 7. DOE/NSF COST BASELINES AT LEVEL 2 (in $000)

**U.S. ATLAS Cost Baseline**

| WBS | Description | Previous | Change | Current |
|---|---|---|---|---|
| 1.1 | Silicon System | 17,755 | 0 | 17,755 |
| 1.2 | Transition Radiation Tracker | 9,194 | 0 | 9,194 |
| 1.3 | Liquid Argon Calorimeter | 42,171 | 0 | 42,171 |
| 1.4 | Tile Calorimeter | 9,148 | 0 | 9,148 |
| 1.5 | Muon Spectrometer | 26,391 | 0 | 26,391 |
| 1.6 | Trigger/Data Acquisition System | 10,957 | 0 | 10,957 |
| 1.7 | Common Projects | 9,179 | 0 | 9,179 |
| 1.8 | Education | 287 | 0 | 287 |
| 1.9 | Project Management | 8,280 | 0 | 8,280 |
| 1.10 | Technical Coordination | 450 | 0 | 450 |
| | Contingency | 29,938 | 0 | 29,938 |
| | U.S. ATLAS Total Project Cost Baseline | 163,750 | 0 | 163,750 |

**U.S. CMS Cost Baseline**

| WBS | Description | Previous | Change | Current |
|---|---|---|---|---|
| 1.1 | Endcap Muon | 35,995 | 68 | 36,063 |
| 1.2 | Hadron Calorimeter | 38,336 | 106 | 38,442 |
| 1.3 | Trigger and Data Acquisition | 13,719 | 22 | 13,741 |
| 1.4 | Electromagnetic Calorimeter | 9,564 | 366 | 9,930 |
| 1.5 | Forward Pixels | 6,756 | 0 | 6,756 |
| 1.6 | Common Projects | 23,000 | 0 | 23,000 |
| 1.7 | Project Office | 7,530 | 39 | 7,569 |
| 1.8 | Silicon | 3,325 | 0 | 3,325 |
| | Contingency | 29,025 | - 601 | 28,424 |
| | U.S. CMS Total Project Cost Baseline | 167,250 | 0 | 167,250 |

**U.S. LHC Accelerator Cost Baseline**

| WBS | Description | Previous | Change | Current |
|---|---|---|---|---|
| 1.1 | Interaction Region Components | 50,328 | 4,779 | 55,107 |
| 1.2 | Radio Frequency Straight Section | 15,714 | 1,434 | 17,148 |
| 1.3 | Superconducting Wire and Cable | 11,868 | 1,458 | 13,326 |
| 1.4 | Accelerator Physics | 5,133 | - 1,056 | 4,077 |
| 1.5 | Project Management | 13,612 | - 74 | 13,538 |
| | Contingency | 13,345 | - 6,541 | 6,804 |
| | U.S. LHC Accelerator Total Project Cost Baseline | 110,000 | 0 | 110,000 |

## 8. SCHEDULE STATUS AND PLANS

### 8.1 U.S. ATLAS Construction Project Milestones

**The milestones have been updated with the new ETC baseline dates.**

**U.S. ATLAS Major Project Milestones (Level 1)**

| Description | Baseline Schedule | Forecast (F) Date | Actual (A) Date |
|---|---|---|---|
| Project Start | 01-Oct-95 | 01-Oct-95 (F) | 01-Oct-95 (A) |
| Project Completion | 30-Sep-05 | 30-Sep-05 (F) | |

**U.S. ATLAS Major Project Milestones (Level 2)**

| **Subsystem** | **Schedule Designator** | **Description** | **Baseline Schedule** | **Forecast (F) / Actual (A) Date** |
|---|---|---|---|---|
| **Silicon (1.1)** | SIL L2/1 | Start Full Silicon Strip Electronics Production | 06-Jul-01 | 15-Jul-01 (F) |
| | SIL L2/2 | Start Full Strip Module Production | 07-Jan-02 | 07-Jan-02 (F) |
| | SIL L2/3 | ROD Design Complete | 01-Oct-01 | 01-Oct-01 (F) |
| | SIL L2/4 | Complete Shipment of Silicon Strip Module Production | 13-Oct-03 | 13-Oct-03 (F) |
| | SIL L2/5 | ROD Production/Testing Complete | 24-Jun-03 | 24-Jun-03 (F) |
| | SIL L2/6 | Pixels 1st IBM Prototype Submitted | 26-Jul-01 | **17-Sep-01 (F)** |
| | SIL L2/7 | Pixels Start IBM Production | 13-Mar-03 | 13-Mar-03 (F) |
| | SIL L2/8 | Pixels Start IBM Outer Bare Module Prod | 22-Oct-03 | 22-Oct-03 (F) |
| | SIL L2/9 | Pixels Disk System at CERN | 13-Oct-04 | 13-Oct-04 (F) |
| **TRT (1.2) Mechanical** | TRT L2/1 | Final Design Complete | 31-Dec-98 | 07-Dec-98 (A) |
| | TRT L2/2 | Module Production Complete (CUM 102) | 31-Mar-03 | 31-Mar-03 (F) |
| | TRT L2/3 | Barrel Construction Complete | 16-Sep-03 | 16-Sep-03 (F) |
| **Electrical** | TRT L2/4 | Select Final Elec Design | 15-Jun-01 | 30-Aug-00 (A) |
| | TRT L2/5 | Start Production of ASICS | 18-Jan-02 | 18-Jan-02 (F) |
| | TRT L2/6 | Installation Complete | 04-Jan-05 | 04-Jan-05 (F) |
| **LAr Cal (1.3)** | LAr L2/1 | Cryostat Contract Award | 24-Jul-98 | 05-Aug-98 (A) |
| | LAr L2/2 | Barrel Feedthroughs Final Design Review | 30-Sep-98 | 02-Oct-98 (A) |
| | LAr L2/3 | Start Electronics Production (Preamps) | 30-Jun-00 | 30-Jun-00 (A) |
| | LAr L2/4 | FCAL Mechanical Design Complete | 14-Dec-98 | 15-Dec-99 (A) |
| | LAr L2/5 | FEB SCA Prod. Chip Submission/Contract Award | 19-Jul-01 | 01-Oct-01 (F) |
| | LAr L2/6 | Level 1 Trigger Final Design Complete | 04-Oct-01 | 04-Oct-01 (F) |
| | LAr L2/7 | ROD Final Design Complete | 12-Dec-02 | 12-Dec-02 (F) |
| | LAr L2/8 | Motherboard System Production Complete | 30-Jun-02 | 30-Jun-02 (F) |
| | LAr L2/9 | Cryostat Arrives at CERN | 15-May-01 | 02-Jul-01 (F) |
| | LAr L2/10 | Barrel Feedthroughs Production Complete | 15-Feb-02 | 15-Feb-02 (F) |
| | LAr L2/11 | FCAL-C Delivered to EC | 17-Oct-02 | 17-Oct-02 (F) |
| | LAr L2/12 | FCAL-A Delivered to EC | 08-Dec-03 | 08-Dec-03 (F) |

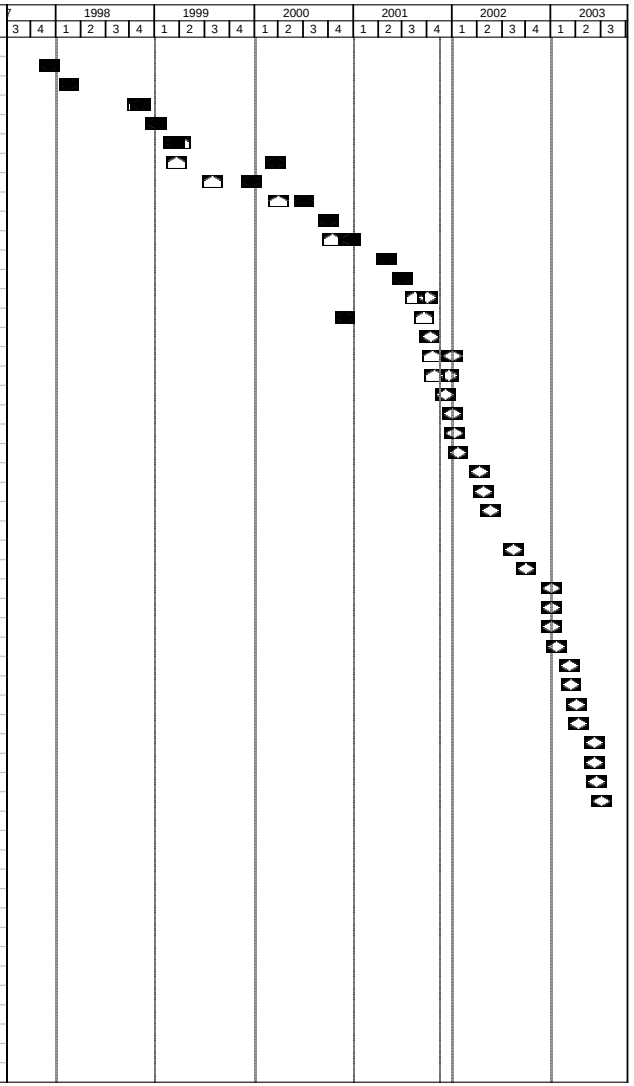
**U.S. ATLAS Major Project Milestones (Level 2) (cont'd)**

| Subsystem | Schedule Designator | Description | Baseline Schedule | Forecast (F) / Actual (A) Date |
|---|---|---|---|---|
| **Tile Cal (1.4)** | Tile L2/1 | Start Submodule Procurement | 01-Sep-97 | 01-Sep-97 (A) |
| | Tile L2/2 | Technology Choice for F/E Electronics | 15-Nov-97 | 15-Nov-97 (A) |
| | Tile L2/3 | Start Module Construction | 01-May-99 | 20-Sep-99 (A) |
| | Tile L2/4 | Start Production of Motherboards | 01-Apr-01 | 30-Mar-01 (A) |
| | Tile L2/5 | All Electronic Components Delivered to CERN | 01-Oct-02 | 01-Oct-02 (F) |
| | Tile L2/6 | Module Construction Complete | 30-Sept-02 | 30-Sep-02 (F) |
| | Tile L2/7 | All Modules Delivered to CERN | 02-Dec-02 | 02-Dec-02 (F) |
| **Muon (1.5)** | Muon L2/1 | Start MDT Chambers Lines 1 and 3 | 17-Jul-00 | 15-Sep-00 (A) |
| | Muon L2/2 | Start CSC Chamber Production | 01-Sep-01 | 01-Sep-01 (F) |
| | Muon L2/3 | MDT Electronics ASD PRR | 19-Oct-01 | 01-Oct-01 (F) |
| | Muon L2/4 | Final Design of Global Alignment Devices Complete | 01-Apr-02 | 01-Apr-02 (F) |
| | Muon L2/5 | CSC IC Production Complete | 15-May-02 | 15-May-02 (F) |
| | Muon L2/6 | Kinematic Mount Design Complete | 30-Jan-01 | 30-Jan-01 (A) |
| | Muon L2/7 | MDT Chambers (U.S.) Production Complete | 27-Aug-04 | 14-Sep-04 (F) |
| | Muon L2/8 | Kinematic Mount Production Complete | 24-May-04 | 24-May-04 (F) |
| | Muon L2/9 | CSC ROD Production Complete | 05-Nov-03 | 05-Nov-03 (F) |
| | Muon L2/10 | MDT Elec.'s Mezzanine Production Complete | 06-Mar-03 | 06-Mar-03 (F) |
| | Muon L2/11 | CSC Assembly/Testing at CERN Complete | 17-Dec-04 | 17-Dec-04 (F) |
| | Muon L2/12 | Global Alignment System Final Delivery | 30-Sep-04 | 30-Sep-04 (F) |
| **Trigger/ DAQ (1.6)** | TDAQ L2/1 | Select Final LVL2 Architecture | 31-Dec-99 | 31-Mar-00 (A) |
| | TDAQ L2/2 | LVL2 Trigger Design Complete | 31-Dec-02 | 31-Dec-02 (F) |
| | TDAQ L2/3 | LVL2 Trigger Prototype Complete | 30-Sep-02 | 30-Sep-02 (F) |
| | TDAQ L2/4 | Start Production | 08-Jan-03 | 08-Jan-03 (F) |
| | TDAQ L2/5 | Start Installation & Commissioning | 05-Mar-03 | 05-Mar-03 (F) |
| | TDAQ L2/6 | Production Complete | 30-Jul-05 | 30-Jul-05 (F) |
| | TDAQ L2/7 | LVL2 Installation & Commissioning Complete | 30-Sep-05 | 30-Sep-05 (F) |

# Project Manager's Quarterly Progress Report –3rd Quarter FY 2001
# U.S. Large Hadron Collider Construction Project

## Figure 8.1.1 U.S. ATLAS Milestone Schedule Status Report

| ID | Milestone | ETC 01 Baseline | Forecast | Actual |
|---|---|---|---|---|
| 1 | Project Start (10/1/95) | Sun 10/1/95 | Sun 10/1/95 | Sun 10/1/95 |
| 2 | Start Submodule Procurement | Mon 9/1/97 | Mon 9/1/97 | Mon 9/1/97 |
| 3 | Technology Choice for F/E Electronics | Sat 11/15/97 | Sat 11/15/97 | Sat 11/15/97 |
| 4 | Cryostat Contract Award | Fri 7/24/98 | Wed 8/5/98 | Wed 8/5/98 |
| 5 | Barrel FTs Final Design Review | Wed 9/30/98 | Fri 10/2/98 | Fri 10/2/98 |
| 6 | Final Design Complete | Thu 12/31/98 | Mon 12/7/98 | Mon 12/7/98 |
| 7 | FCAL Mech Design Complete | Mon 12/14/98 | Wed 12/15/99 | Wed 12/15/99 |
| 8 | Start Module Construction | Sat 5/1/99 | Mon 9/20/99 | Mon 9/20/99 |
| 9 | Select Final LVL2 Architecture | Fri 12/31/99 | Fri 3/31/00 | Fri 3/31/00 |
| 10 | Start Elec.'s Production (Preamps) | Fri 6/30/00 | Fri 6/30/00 | Fri 6/30/00 |
| 11 | Start MDT Chambers Lines 1 & 3 | Mon 7/17/00 | Fri 9/15/00 | Fri 9/15/00 |
| 12 | Kinematic Mount Design Complete | Tue 1/30/01 | Tue 1/30/01 | Tue 1/30/01 |
| 13 | Start Production of MBs | Sun 4/1/01 | Fri 3/30/01 | Fri 3/30/01 |
| 14 | Cryostat Arrives at CERN | Tue 5/15/01 | Mon 7/2/01 | NA |
| 15 | Select Final Elec Design | Fri 6/15/01 | Wed 8/30/00 | Wed 8/30/00 |
| 16 | Start Full Silicon Strip Elec Production | Fri 7/6/01 | Sun 7/15/01 | NA |
| 17 | FEB SCA Prod Chip Submission/CA | Thu 7/19/01 | Mon 10/1/01 | NA |
| 18 | Pixels '1st IBM Prototype Submitted' | Thu 7/26/01 | **Mon 9/17/01** | NA |
| 19 | Start CSC Chamber Production | Sat 9/1/01 | Sat 9/1/01 | NA |
| 20 | ROD Design Complete | Mon 10/1/01 | Mon 10/1/01 | NA |
| 21 | Level 1 Trigger Final Design Complete | Thu 10/4/01 | Thu 10/4/01 | NA |
| 22 | MDT Electronics ASD PRR | Fri 10/19/01 | Fri 10/19/01 | NA |
| 23 | Start Full Strip Module Production | Mon 1/7/02 | Mon 1/7/02 | NA |
| 24 | Start Production of ASICS | Fri 1/18/02 | Fri 1/18/02 | NA |
| 25 | Barrel FTs Production Complete | Fri 2/15/02 | Fri 2/15/02 | NA |
| 26 | Final Design of Global Align Devices | Mon 4/1/02 | Mon 4/1/02 | NA |
| 27 | CSC IC Production Complete | Wed 5/15/02 | Wed 5/15/02 | NA |
| 28 | MB System Production Complete | Sun 6/30/02 | Sun 6/30/02 | NA |
| 29 | LVL2 Trigger Prototype Complete | Mon 9/30/02 | Mon 9/30/02 | NA |
| 30 | Module Construction Complete | Mon 9/30/02 | Mon 9/30/02 | NA |
| 31 | All Elec.'s Components Delivered to ATLAS | Tue 10/1/02 | Tue 10/1/02 | NA |
| 32 | FCAL-C Delivered to EC | Thu 10/17/02 | Thu 10/17/02 | NA |
| 33 | All Modules Delivered to CERN | Mon 12/2/02 | Mon 12/2/02 | NA |
| 34 | ROD Final Design Complete | Thu 12/12/02 | Thu 12/12/02 | NA |
| 35 | LVL2 Trigger Design Complete | Tue 12/31/02 | Tue 12/31/02 | NA |
| 36 | Start Production | Wed 1/8/03 | Wed 1/8/03 | NA |
| 37 | Start Installation & Commissioning | Wed 3/5/03 | Wed 3/5/03 | NA |
| 38 | MDT Elec.'s Mezz Production Complete | Thu 3/6/03 | Thu 3/6/03 | NA |
| 39 | Pixels 'Start IBM Production' | Thu 3/13/03 | Thu 3/13/03 | NA |
| 40 | Module Production Complete (CUM 102) | Mon 3/31/03 | Mon 3/31/03 | NA |
| 41 | ROD Production/Testing Complete | Tue 6/24/03 | Tue 6/24/03 | NA |
| 42 | Barrel Construction Complete | Tue 9/16/03 | Tue 9/16/03 | NA |
| 43 | Compl Shipment of Silicon Strip Modules Prod | Mon 10/13/03 | Mon 10/13/03 | NA |
| 44 | Pixels 'Start IBM Outer Bare Module Prod' | Wed 10/22/03 | Wed 10/22/03 | NA |
| 45 | CSC ROD Production Complete | Wed 11/5/03 | Wed 11/5/03 | NA |
| 46 | FCAL-A Delivered to EC | Mon 12/8/03 | Mon 12/8/03 | NA |
| 47 | Kinematic Mount Production Complete | Mon 5/24/04 | Mon 5/24/04 | NA |
| 48 | MDT Chambers (U.S.) Prod Compl (Qty. 240) | Fri 8/27/04 | Tue 9/14/04 | NA |
| 49 | Global Align System Final Delivery | Thu 9/30/04 | Thu 9/30/04 | NA |
| 50 | Pixels 'Disk System at CERN' | Wed 10/13/04 | Wed 10/13/04 | NA |
| 51 | CSC Assembly/Test at CERN Complete | Fri 12/17/04 | Fri 12/17/04 | NA |
| 52 | Installation Complete | Tue 1/4/05 | Tue 1/4/05 | NA |
| 53 | Production Complete | Sat 7/30/05 | Sat 7/30/05 | NA |
| 54 | Installation & Commissioning Complete | Fri 9/30/05 | Fri 9/30/05 | NA |



## 8.2 U.S. CMS Construction Project Milestones

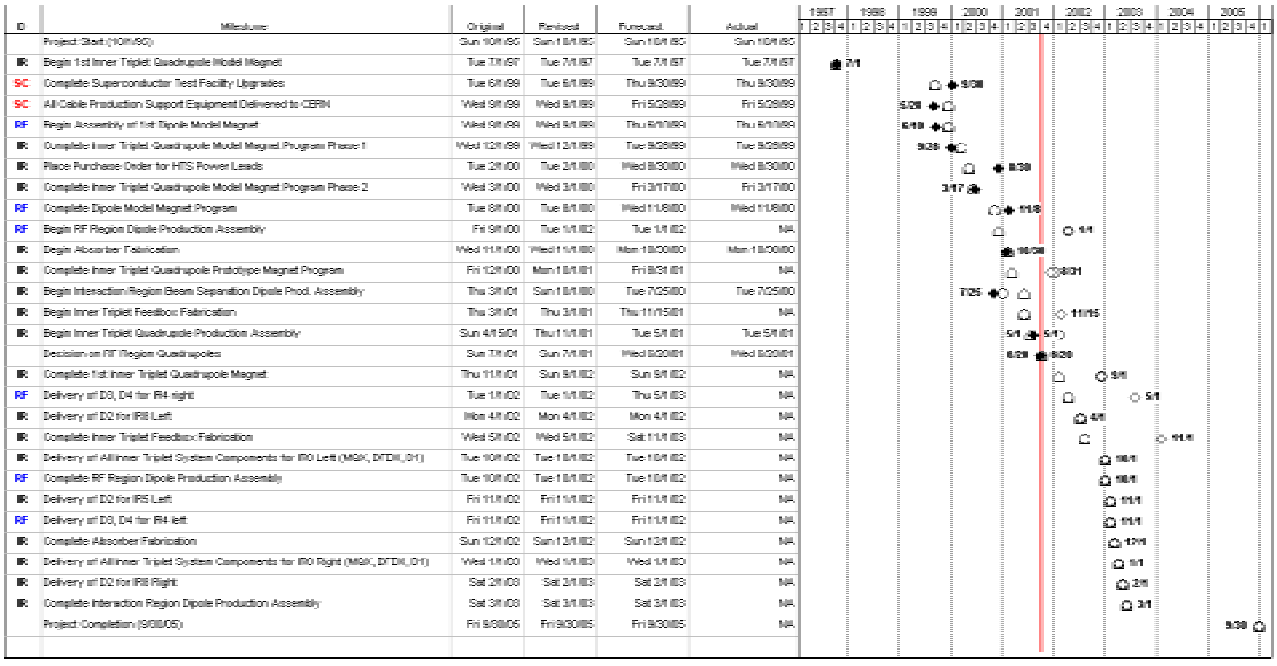
| System | Level? | CMS ID | Milestone | Baseline Start | Start | Variance |
|---|---|---|---|---|---|---|
| | | | **CMS L1 Milestones** | **NA** | **Oct 31 '95** | **0 days** |
| CMS1 | ML1 | | Project Start (10/31/95) | Oct 31 '95 | Oct 31 '95 | 0 days |
| CMS1 | ML1 | D-004 | Submit Trigger Technical Design Report (TDR) | Nov 30 '00 | Nov 30 '00 | 0 days |
| CMS1 | ML1 | D-014 | Submit DAQ Technical Design Report (TDR) | Dec 31 '01 | Dec 31 '01 | 0 days |
| CMS1 | ML1 | HB-017 | End Assembly of HB (Barrel) in Surface Hall (SX5) | Jul 31 '02 | Jul 31 '02 | 0 days |
| CMS1 | ML1 | HE-012 | End Assembly of HE (Endcap) in SX5 | Mar 31 '03 | Mar 31 '03 | 0 days |
| CMS1 | ML1 | HB-018 | End Trial Insertion of HB in Vacuum Tank | May 01 '03 | Jul 31 '03 | 65 days |
| CMS1 | ML1 | E-015 | Trial Mounting of EB Supermodule on HB Complete | Aug 31 '03 | Aug 31 '03 | 0 days |
| CMS1 | ML1 | S-022 | Close Yoke and Start Magnet Test in SX5 | Sep 30 '03 | Sep 30 '03 | 0 days |
| CMS1 | ML1 | HB-023 | End Installation and Test of HB in UX5 | May 31 '04 | May 31 '04 | 0 days |
| CMS1 | ML1 | HE-015 | End Installation and Test of HE in UX5 | Jul 31 '04 | Jul 31 '04 | 0 days |
| CMS1 | ML1 | E-019 | End Inst., Testing, & Debug. of EB (barrel) in UX5 | Oct 31 '04 | Oct 31 '04 | 0 days |
| CMS1 | ML1 | M-019 | End Install. of ME (Endcap) Stations in YE in UX5 | Mar 31 '05 | Mar 31 '05 | 0 days |
| CMS1 | ML1 | T-014 | End Installation and Test of Tracker in UX5 | Jun 30 '05 | Jun 30 '05 | 0 days |
| CMS1 | ML1 | HF-025 | End Installation and Test of HF in UX5 | Jun 30 '05 | Jun 30 '05 | 0 days |
| CMS1 | ML1 | | Project Completion (8/08/05) | Sep 30 '05 | Sep 30 '05 | 0 days |
| | | | **Muon System (WBS 1.3)** | **NA** | **Dec 02 '98** | **0 days** |
| MUON | ML2 | M-009 | Mechanical Engineering Design Review | Dec 31 '98 | Dec 02 '98 | -14 days |
| MUON | ML2 | M-010 | Begin Mass Production of CSC Parts (panels) | Apr 30 '99 | May 31 '99 | 21 days |
| MUON | ML2 | M-011 | Begin Assembly of Cathode Strip Chambers at FNAL | Oct 31 '99 | Jul 14 '00 | 173 days |
| MUON | ML2 | M-012 | Pre-Production ASIC's Ready | Nov 30 '99 | Aug 01 '00 | 164 days |
| MUON | ML2 | M-013 | Begin Mass Production of Electronics Boards | Aug 31 '00 | Jan 04 '01 | 80 days |
| MUON | ML2 | M-014 | Begin Mounting Electronics and Testing at UCLA/SF | Sep 30 '00 | Oct 31 '01 | 273 days |
| MUON | ML2 | M-015 | Begin CSC Assembly PNPI(St. Petersburg & IHEP(Beijing | Jan 31 '01 | Sep 30 '01 | 173 days |
| MUON | ML2 | M-016 | 50% of the Chambers Installed | Jul 31 '03 | Jul 31 '03 | 0 days |
| MUON | ML2 | M-017 | All Large Chambers Assembled and Tested | Oct 31 '03 | Oct 31 '03 | 0 days |
| MUON | ML2 | M-018 | All Chambers Installed | Mar 31 '04 | Mar 31 '04 | 0 days |
| | | | **HCAL System (WBS 1.2)** | **NA** | **Oct 02 '98** | **0 days** |
| HCAL | ML2 | HB-030 | HB: FFP1 Absorber Delivered to CERN | Oct 31 '98 | Oct 02 '98 | -21 days |
| HCAL | ML2 | HB-001 | HB: Mechanical Engineering Design Review | Nov 30 '98 | Nov 03 '98 | -19 days |
| HCAL | ML2 | HB-032 | HB: FFP2 Absorber Delivered to CERN | Apr 28 '99 | Apr 15 '99 | -9 days |
| HCAL | ML2 | HO-001 | HO Engineering Design Review | Jun 18 '99 | Jun 02 '99 | -4 days |
| HCAL | ML2 | HB-001 | HE Mechanical Engineering Design Review | Sep 30 '99 | Jun 12 '99 | -78 days |
| HCAL | ML2 | HF-006 | HF Engineering Design Review Complete | Oct 31 '00 | Aug 31 '01 | 208 days |

| System | Level? | CMS ID | Milestone | Baseline Start | Start | Variance |
|---|---|---|---|---|---|---|
| HCAL | ML2 | HB-030 | HB-1 Absorber Delivered to CERN | Nov 30 '00 | Nov 30 '00 | 0 days |
| HCAL | ML2 | HF-028 | HF: Define Fiber Diameter | Jan 31 '01 | Jan 31 '01 | 0 days |
| HCAL | ML2 | HB-039 | Complete Front-end Electronics Production | Jun 30 '01 | Oct 31 '02 | 337 days |
| HCAL | ML2 | HB-034 | HB+1 Absorber Delivered to CERN | Dec 31 '01 | Dec 31 '01 | 0 days |
| HCAL | ML2 | HO-003 | HO Optics Installation on YB Completed | Jun 30 '03 | Jun 30 '03 | 0 days |
| HCAL | ML2 | HB-031 | HB: End Installation in Solenoid in UX5 | Dec 01 '03 | Mar 31 '04 | 73 days |
| HCAL | ML2 | HO-007 | HO End Installation and Tests in UX5 | Apr 30 '05 | Apr 30 '05 | 0 days |
| | | | **Trigger System (WBS 1.3)** | **NA** | **Nov 03 '98** | **0 days** |
| TRIG | ML2 | D-001 | Complete Initial Muon, Calorimeter, & Global Trigger Desig | Nov 30 '98 | Nov 03 '98 | -19 days |
| DAQ | ML2 | D-005 | Readout Unit Prototype 2 (Design of) | May 18 '99 | May 18 '99 | 0 days |
| DAQ | ML2 | D-006 | Event Builder Prototype 1 Complete | May 31 '99 | May 04 '99 | -19 days |
| TRIG | ML2 | D-002 | Complete Phase 1 Prototype Design | Nov 30 '99 | Nov 02 '99 | -20 days |
| DAQ | ML2 | D-007 | Readout Unit Prototype 2 Complete | Nov 30 '99 | Nov 02 '99 | -20 days |
| DAQ | ML2 | D-008 | Filter Unit Prototype 1 Complete | Nov 30 '99 | Nov 02 '99 | -20 days |
| DAQ | ML2 | D-009 | Vertical DAQ Chain Prototype Complete | Nov 30 '99 | Nov 02 '99 | -20 days |
| DAQ | ML2 | D-010 | High Level Trigger Prototype 1 Complete | Nov 30 '99 | Nov 02 '99 | -20 days |
| DAQ | ML2 | D-011 | Full DAQ Prototype Tests Complete | May 01 '00 | Jun 30 '00 | 44 days |
| DAQ | ML2 | D-013 | Technologies Choice Preparation: real 1 H DAQ | Nov 01 '00 | Nov 30 '00 | 21 days |
| | | | **ECAL system (WBS 1.4)** | **NA** | **Jun 01 '98** | **0 days** |
| ECAL | ML2 | E-001 | Choice of Avalanche Photodiodes | Jun 30 '98 | Jun 01 '98 | -21 days |
| ECAL | ML2 | E-004 | 500 Electronics Channels Test | Dec 31 '99 | Dec 31 '01 | 308 days |
| ECAL | ML2 | E-006 | Module 0 (400 channels) Prototype Complete | Dec 31 '99 | Aug 31 '01 | 421 days |
| ECAL | ML2 | E-008 | Supermodule 1 Completed | Jun 30 '01 | Mar 31 '02 | 483 days |
| ECAL | ML2 | E-011 | Supermodule 1 Calibration and Testing Complete | Aug 31 '01 | Mar 31 '02 | 148 days |
| ECAL | ML2 | E-013 | Half-Barrel (18 Supermodules) Calibrated | Sep 30 '02 | Sep 30 '02 | 0 days |
| ECAL | ML2 | E-017 | Full-Barrel (36 Supermodules) Completed | Jun 30 '04 | Jun 30 '04 | 0 days |
| | | | **FPIX System (WBS 1.5)** | **NA** | **Dec 01 '98** | **0 days** |
| FPIX | ML2 | T-012 | Define construction milestones up to 2005 | Jul 01 '99 | Jun 30 '01 | 301 days |
| FPIX | ML2 | T-001 | Final Full Size Sensor - Submission | Jun 31 '01 | Aug 31 '01 | 152 days |
| FPIX | ML2 | T-002 | Final Full Size Readout Chip - Submission | Feb 28 '01 | May 31 '02 | 316 days |
| | | | **Common Projects (WBS 1.6)** | **NA** | **Jun 30 '99** | **0 days** |
| | ML2 | | ***Baseline Milestone Symbol (CMS 'Z' Schedule)*** | Nil | Oct 02 '99 | *0 days* |
| | ML2 | | ***Projected Milestone Symbol*** | Nil | Oct 02 '99 | *0 days* |
| | ML2 | | ***Achieved Milestone Symbol*** | Nil | Oct 02 '99 | *0 days* |

## 8.3 U.S. LHC Accelerator Construction Project Milestones

Table 8.3 Level 2 U.S. LHC Accelerator Baseline Milestones through FY2001

| WBS Identifiers | Milestone Description | Baseline Date | Forecast(F) or Actual(A) |
|---|---|---|---|
| Project | Decision as to whether or not the US Project includes RF region quadrupoles | 1 Jul 01 | **20 Jun 01 (A)** |
| Int Region | Begin 1st inner triplet quadrupole model magnet | 1 Jul 97 | 1 Jul 97 (A) |
| Int Region | Complete inner triplet quadrupole model magnet program phase 1 | 1 Dec 99 | 28 Sep 99 (A) |
| Int Region | Complete inner triplet quadrupole model magnet program phase 2 | 1 Mar 00 | 17 Mar 00 (A) |
| Int Region | Place purchase order for HTS power leads | 1 Feb 00 | 30 Aug 00 (A) |
| Int Region | Begin absorber fabrication | 1 Nov 00 | 30 Oct 00 (A) |
| Int Region | Complete inner triplet quadrupole prototype program | 1 Oct 01 | **1 Sep 01 (F)** |
| Int Region | Begin IR beam separation dipole production assembly | 1 Oct 00 | 25 Jul 00 (A) |
| Int Region | Begin inner triplet feedbox fabrication | 1 Mar 01 | **15 Nov 01 (F)** |
| Int Region | Begin inner triplet quadrupole production assembly | 1 Nov 01 | **1 May 01 (A)** |
| Int Region | Complete 1st inner triplet quadrupole magnet | 1 Sep 02 | 1 Sep 02 (F) |
| Int Region | Delivery of D2 for IR8 left | 1 Apr 02 | 1 Apr 02 (F) |
| Int Region | Complete inner triplet feedbox fabrication | 1 May 02 | **1 Nov 03 (F)** |
| | | | |
| RF Region | Begin assembly of 1st dipole model magnet | 1 Sep 99 | 10 Jun 99 (A) |
| RF Region | Complete dipole model magnet program | 1 Aug 00 | 8 Nov 00 (A) |
| RF Region | Begin RF region dipole production assembly | 1 Jan 02 | 1 Jan 02 (F) |
| RF Region | Delivery of D3, D4 for IR4 right | 1 Jan 02 | 1 May 03 (F) |
| | | | |
| SC Cable | All cable prod. support equipment delivered to CERN | 1 Sep 99 | 28 May 99 (A) |
| SC Cable | Complete SC testing facility upgrades | 1 Jun 99 | 30 Sep 99 (A) |



## 9. TECHNICAL BASELINE STATUS

U.S. ATLAS Construction Project - No change. The U.S. ATLAS collaboration defined a list of initial deliverables representing the U.S. contribution to ATLAS. This list was approved by the JOG in March 1998. Deliverables are listed in the U.S. ATLAS Construction Project Management Plan, Appendix 3.

U.S. CMS Construction Project - Change to incorporate expanded U.S. CMS participation in the CMS Silicon Tracker Outer Barrel, per approved Level 2 Change Request defining additional associated deliverables, milestones, cost and schedule. The U.S. CMS collaboration defined a list of deliverables representing the U.S. contribution to CMS. This list was approved by the JOG in October 1998. The scope of U.S. CMS contribution is described in the U.S. CMS Management Plan, Appendix 2.

U.S. LHC Accelerator Construction Project - No change. U.S. LHC Accelerator Project - The U.S. deliverables to CERN are defined in the Implementing Arrangement to the Accelerator Protocol. The Implementing Arrangement was signed by the CERN and U.S. signatories in July 1998. Reference the U.S. LHC Accelerator Project Management Plan, Annex II, (Approved 6/15/98).

CERN Direct Purchases - No change. CERN will procure from U.S. industrial firms supplies required to construct the LHC accelerator. These supplies will include superconducting alloy, cable, insulation, and other materials.

## 10. BASELINE CHANGE ACTIVITY

| Baseline Control Level | Baseline Changes |
|---|---|
| Level 1, DOE/NSF Joint Oversight Group | No changes this quarter |
| Level 2, DOE/NSF Project Office | |
| U.S. ATLAS | No changes this quarter. |
| U.S. CMS | Changes to the Level 2 cost, scope and schedule baseline. |
| U.S. LHC Accelerator | Changes to the Level 2 cost, scope and schedule baseline. |

# Project Manager's Quarterly Progress Report –3rd Quarter FY 2001
# U.S. Large Hadron Collider Construction Project

## APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars)

**U.S. CMS Construction Project**

| | FY 1998 | | | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DOE | | | | DOE | | | | DOE | | | | DOE | | | | Grand |
| Institution | Grant | Contract | NSF | Total | Grant | Contract | NSF | Total | Grant | Contract | NSF | Total | Grant | Contract | NSF | Total | Total |
| FNAL | 0 | 5,517 | 0 | 5,517 | 0 | 10,817 | 40 | 10,857 | 0 | 5,981 | 0 | 5,981 | 0 | 6,033 | 0 | 6,033 | 28,388 |
| Fairfield | 0 | 29 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 0 | 13 | 0 | 13 | 52 |
| Maryland | 90 | 65 | 0 | 155 | 0 | 132 | 131 | 263 | 0 | 250 | 0 | 250 | 0 | 189 | 0 | 189 | 857 |
| Boston U. | 0 | 32 | 0 | 32 | 31 | 111 | 0 | 142 | 0 | 132 | 0 | 132 | 0 | 88 | 0 | 88 | 394 |
| Florida State | 60 | 54 | 0 | 114 | 71 | 118 | 0 | 189 | 80 | 54 | 0 | 134 | 68 | 43 | 0 | 111 | 548 |
| U. of Minnesota | 60 | 95 | 0 | 155 | 161 | 452 | 0 | 613 | 141 | 202 | 0 | 343 | 153 | 401 | 0 | 554 | 1,665 |
| U. of Iowa | 77 | 62 | 0 | 139 | 20 | 5 | 0 | 25 | 0 | 453 | 0 | 453 | 0 | 843 | 0 | 843 | 1,460 |
| U. of Rochester | 127 | 1,159 | 0 | 1,286 | 262 | 485 | 0 | 747 | 441 | 253 | 0 | 694 | 464 | 143 | 0 | 607 | 3,334 |
| Notre Dame | 0 | 52 | 0 | 52 | 0 | 44 | 184 | 228 | 0 | 14 | 193 | 207 | 0 | 14 | 112 | 126 | 613 |
| Purdue | 38 | 135 | 0 | 173 | 49 | 166 | 0 | 215 | 0 | 175 | 0 | 175 | 0 | 89 | 0 | 89 | 652 |
| U. of Miss. | 46 | 100 | 0 | 146 | 68 | 91 | 0 | 159 | 69 | 108 | 0 | 236 | 0 | 235 | 0 | 235 | 776 |
| U. of Florida | 44 | 95 | 0 | 139 | 184 | 412 | 0 | 596 | 332 | 853 | 0 | 1,185 | 432 | 293 | 0 | 725 | 2,645 |
| Ohio State U. | 140 | 64 | 0 | 204 | 275 | 212 | 0 | 487 | 196 | 732 | 0 | 928 | 151 | 700 | 0 | 851 | 2,470 |
| Carnegie Mellon | 0 | 113 | 0 | 113 | 0 | 291 | 0 | 291 | 0 | 312 | 0 | 312 | 0 | 258 | 0 | 258 | 974 |
| Rice | 138 | 19 | 0 | 157 | 102 | 56 | 0 | 158 | 132 | 16 | 0 | 148 | 196 | 36 | 0 | 232 | 695 |
| U. of Wisconsin | 533 | 1,052 | 0 | 1,585 | 471 | 3,598 | 0 | 4,069 | 722 | 2,995 | 0 | 3,717 | 504 | 4,489 | 0 | 4,993 | 14,364 |
| U.C. Davis | 34 | 100 | 0 | 134 | 0 | 78 | 0 | 78 | 0 | 502 | 0 | 502 | 0 | 63 | 0 | 63 | 777 |
| UCLA | 150 | 87 | 0 | 237 | 249 | 173 | 0 | 422 | 244 | 391 | 0 | 635 | 347 | 546 | 42 | 935 | 2,229 |
| U.C. Riverside | 20 | 10 | 0 | 30 | 0 | 164 | 0 | 164 | 0 | 70 | 0 | 70 | 0 | 72 | 0 | 72 | 336 |
| John Hopkins | 0 | 29 | 0 | 29 | 0 | 0 | 70 | 70 | 0 | 0 | 40 | 40 | 0 | 0 | 5 | 5 | 144 |
| Northwestern | 0 | 59 | 0 | 59 | 5 | 26 | 0 | 31 | 0 | 114 | 0 | 114 | 0 | 39 | 0 | 39 | 243 |
| Rutgers | 0 | 13 | 0 | 13 | 0 | 0 | 34 | 34 | 0 | 2 | 140 | 142 | 0 | 0 | 101 | 101 | 290 |
| Princeton | 0 | 256 | 0 | 256 | 0 | 626 | 0 | 626 | 0 | 667 | 0 | 667 | 0 | 133 | 0 | 133 | 1,682 |
| Caltech | 0 | 148 | 0 | 148 | 0 | 458 | 0 | 458 | 0 | 367 | 0 | 367 | 0 | 452 | 0 | 452 | 1,425 |
| U.C. San Diego | 11 | 0 | 0 | 11 | 11 | 90 | 24 | 125 | 36 | 0 | 0 | 36 | 0 | 43 | 0 | 43 | 215 |
| Northeastern | 0 | 0 | 0 | 0 | 0 | 0 | 3,370 | 3,370 | 0 | 0 | 1,741 | 1,741 | 0 | 0 | 1,482 | 1,482 | 6,593 |
| U. Ill.-Chicago | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 124 | 0 | 0 | 309 | 309 | 0 | 0 | 262 | 262 | 695 |
| U. of Nebraska | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 24 | 0 | 0 | 2 | 2 | 0 | 0 | 100 | 100 | 126 |
| MIT | 0 | 37 | 0 | 37 | 15 | 67 | 0 | 82 | 0 | 78 | 0 | 78 | 0 | 87 | 0 | 87 | 284 |
| Iowa State | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 19 | 0 | 356 | 0 | 356 | 0 | 29 | 0 | 29 | 404 |
| Kansas State | | | | | | | | | | | | | 0 | 66 | 0 | 66 | 66 |
| LBL | | | | | | | | | | | | | 0 | 554 | 0 | 554 | 554 |
| Texas Tech | | | | | | | | | | | | | 0 | 876 | 0 | 876 | 876 |
| UC Santa Barbara | | | | | | | | | | | | | 0 | 13 | 0 | 13 | 13 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U. of Kansas | | | | | | | | | | | | | 0 | 0 | 6 | 6 | 6 |
| **Subtotal** | 1,568 | 9,382 | 0 | 10,950 | 1,974 | 18,672 | 4,020 | 24,666 | 2,393 | 15,087 | 2,425 | 19,964 | 2,315 | 16,840 | 2,110 | 21,265 | 75,330 |

## APPENDIX B - FUNDING BY INSTITUTION (in thousands of dollars)

| U.S. ATLAS Construction Project | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FY 1998 | | | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | | |
| | DOE | | | | DOE | | | | DOE | | | | DOE | | | | Grand |
| Institution | Grant | Contract | NSF | Total | Grant | Contract | NSF | Total | Grant | Contract | NSF | Total | Grant | Contra | NSF | Total | Total |
| ANL | 0 | 1,098 | 0 | 1,098 | 0 | 967 | 0 | 967 | 0 | 922 | 0 | 922 | 0 | 172 | 0 | 172 | 3,159 |
| BNL | 0 | 3,903 | 0 | 3,903 | 0 | 2,581 | 0 | 2,581 | 0 | 6,429 | 0 | 6,429 | 0 | 6,630 | 0 | 6,630 | 19,543 |
| LBNL | 0 | 633 | 0 | 633 | 0 | 715 | 0 | 715 | 0 | 420 | 0 | 420 | 0 | 1,575 | 0 | 1,575 | 3,343 |
| SUNY/Albany | 20 | 0 | 0 | 20 | 48 | 0 | 0 | 48 | 50 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 118 |
| U. of Arizona | 320 | 100 | 0 | 420 | 634 | 0 | 0 | 634 | 557 | 0 | 0 | 557 | 298 | 0 | 0 | 298 | 1,909 |
| Boston U. | 224 | 0 | 0 | 224 | 298 | 0 | 0 | 298 | 287 | 0 | 0 | 287 | 155 | 0 | 0 | 155 | 964 |
| Brandeis U. | 265 | 45 | 0 | 310 | 0 | 0 | 593 | 593 | 0 | 0 | 478 | 478 | 0 | 0 | 731 | 731 | 2,112 |
| U.C.Irvine | 193 | 0 | 0 | 193 | 0 | 0 | 93 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 266 | 266 | 552 |
| U.C. Santa Cruz | 404 | 0 | 0 | 404 | 63 | 0 | 0 | 63 | 0 | 0 | 568 | 568 | 0 | 0 | 2,702 | 2,702 | 3,107 |
| U. of Chicago | 0 | 54 | 0 | 54 | 0 | 0 | 1,069 | 1,069 | 0 | 0 | 264 | 264 | 0 | 0 | 723 | 723 | 2,110 |
| Duke U. | 190 | 0 | 0 | 190 | 601 | 0 | 0 | 601 | 417 | 0 | 0 | 417 | 501 | 0 | 0 | 501 | 1,709 |
| Hampton U. | 0 | 0 | 0 | 0 | 0 | 0 | 538 | 538 | 0 | 0 | 293 | 293 | 0 | 0 | 331 | 331 | 1,162 |
| Harvard | 234 | 0 | 0 | 234 | 0 | 0 | 654 | 654 | 0 | 0 | 390 | 390 | 0 | 0 | 3,882 | 3,882 | 5,070 |
| U. of Illinois | 50 | 159 | 0 | 209 | 347 | 0 | 0 | 347 | 294 | 0 | 0 | 294 | 76 | 0 | 0 | 76 | 926 |
| Indiana U. | 190 | 0 | 0 | 190 | 765 | 0 | 0 | 765 | 460 | 0 | 0 | 460 | 0 | 616 | 0 | 616 | 2,031 |
| MIT | 50 | 0 | 0 | 50 | 105 | 0 | 0 | 105 | 177 | 0 | 0 | 177 | 190 | 0 | 0 | 190 | 522 |
| Michigan State | 0 | 35 | 0 | 35 | 0 | 0 | 178 | 178 | 0 | 0 | 293 | 293 | 0 | 0 | 0 | 0 | 506 |
| Nevis/Columbia | 0 | 675 | 0 | 675 | 0 | 0 | 2,680 | 2,680 | 0 | 0 | 1,422 | 1,422 | 0 | 0 | 103 | 103 | 4,880 |
| U. of New Mex. | 20 | 0 | 0 | 20 | 30 | 0 | 0 | 30 | 24 | 0 | 0 | 24 | 0 | 80 | 0 | 80 | 154 |
| Northern Illinois | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ohio State U. | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 100 | 45 | 0 | 0 | 45 | 0 | 0 | 0 | 0 | 145 |
| U. of Michigan | 62 | 254 | 0 | 316 | 716 | 0 | 0 | 716 | 518 | 0 | 0 | 518 | 681 | 0 | 0 | 681 | 2,231 |
| U. of Oklahoma | 30 | 0 | 0 | 30 | 0 | 0 | 41 | 41 | 0 | 0 | 51 | 51 | 0 | 0 | 49 | 0 | 171 |
| U. of Penn. | 250 | 0 | 0 | 250 | 300 | 0 | 0 | 300 | 265 | 0 | 0 | 265 | 679 | 0 | 0 | 679 | 1,494 |
| U. of Pittsburg | 110 | 0 | 0 | 110 | 0 | 0 | 150 | 150 | 0 | 0 | 210 | 210 | 0 | 50 | 0 | 50 | 520 |
| U. of Rochester | 0 | 0 | 0 | 0 | 0 | 0 | 3,587 | 3,587 | 0 | 0 | 1,664 | 1,664 | 0 | 0 | 0 | 0 | 5,251 |
| U.T. Arlington | 50 | 82 | 0 | 132 | 0 | 0 | 474 | 474 | 0 | 0 | 230 | 230 | 0 | 0 | 0 | 0 | 836 |
| S. Methodist | 40 | 0 | 0 | 40 | 124 | 0 | 0 | 124 | 30 | 0 | 0 | 30 | 87 | 0 | 0 | 87 | 281 |
| SUNY/Stony B. | 27 | 0 | 0 | 27 | 0 | 0 | 1,045 | 1,045 | 0 | 0 | 1,037 | 1,037 | 0 | 0 | 426 | 426 | 2,535 |
| Tufts University | 50 | 0 | 0 | 50 | 20 | 0 | 0 | 20 | 20 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 90 |
| U. Washington | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 240 | 0 | 0 | 318 | 318 | 0 | 0 | 1,377 | 1,377 | 1,935 |
| U. of Wisconsin | 230 | 0 | 0 | 230 | 429 | 0 | 0 | 429 | 665 | 0 | 0 | 665 | 1,014 | 0 | 0 | 1,014 | 2,338 |
| **Subtotal** | 3,009 | 7,038 | 0 | 10,047 | 4,580 | 4,263 | 11,342 | 20,185 | 3,809 | 7,771 | 7,218 | 18,798 | 3,920 | 9,123 | 10,590 | 22,625 | 71,704 |
| Reserve | 0 | 3 | 0 | 3 | 157 | 0 | 5,289 | 5,446 | 327 | 1,936 | 1,795 | 4,058 | 0 | 300 | 0 | 300 | 9,807 |
| | | | | | | | | | 0 | 2,602 | 2,928 | 5,530 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 3,009 | 7,041 | 0 | 10,050 | 4,737 | 4,263 | 16,631 | 25,631 | 4,136 | 12,309 | 11,941 | 28,386 | 3,920 | 9,423 | 10,590 | 22,925 | 81,511 |